

Safety Data Sheet

Cyanogen bromide

Division of Safety
National Institutes
of Health



WARNING!

THIS COMPOUND IS ACUTELY TOXIC. IT IS READILY ABSORBED BY VARIOUS BODY TISSUES THROUGH THE SKIN AND RESPIRATORY AND INTESTINAL TRACTS. IT MAY CAUSE SEVERE IRRITATION OF TISSUES (SKIN, EYES, MUCOUS MEMBRANES, AND LUNGS). AVOID FORMATION AND BREATHING OF AEROSOLS OR VAPORS.

LABORATORY OPERATIONS SHOULD BE CONDUCTED IN A FUME HOOD, GLOVE BOX, OR VENTILATED CABINET.

AVOID SKIN CONTACT: IF EXPOSED, WASH WITH SOAP AND WATER. AVOID WASHING WITH SOLVENTS. AVOID RUBBING OF SKIN OR INCREASING ITS TEMPERATURE.

IN CASE OF FIRE, USE CARBON DIOXIDE OR DRY CHEMICAL EXTINGUISHER.

FOR EYE EXPOSURE, IRRIGATE IMMEDIATELY WITH LARGE AMOUNTS OF WATER. FOR INGESTION, INDUCE VOMITING. REFER FOR GASTRIC LAVAGE. FOR INHALATION, REMOVE VICTIM PROMPTLY TO CLEAN AIR. ADMINISTER RESCUE BREATHING IF NECESSARY. REFER TO PHYSICIAN.

IN CASE OF LABORATORY SPILL, WEAR PROTECTIVE CLOTHING DURING CLEANUP. AVOID SKIN CONTACT OR BREATHING OF AEROSOLS OR VAPORS. USE ALKALINE SOLUTIONS TO DISSOLVE COMPOUND. USE ABSORBENT PAPER TO MOP UP SPILL. WASH DOWN AREA WITH 4% SODIUM HYDROXIDE FOLLOWED BY 5% SODIUM HYPOCHLORITE FOLLOWED BY WATER. DISPOSE OF WASTE SOLUTIONS AND MATERIALS APPROPRIATELY.

A. Background

Cyanogen bromide is a crystalline, volatile solid at ordinary temperatures. It is readily absorbed by inhalation, ingestion, and

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through the skin. Its toxic effects are those of hydrogen cyanide and in addition, particularly at low dosage, it is highly irritating to the eyes, nose, and respiratory tract. Its main laboratory uses are as an analytical reagent in the determination of nicotinic acid; in affinity chromatography for the activation of agarose beads (e.g., Nishikawa and Bailon, 1975; Cuatrecasas and Anfinsen, 1977; Johnson and Garvey, 1977); and in protein structure analysis through specific cleavage at methionine (Gross and Witkop, 1962; Nordwig and Dick, 1965) and tryptophan (Huang et al., 1983) residues.

No officially approved permissible exposure limit for cyanogen bromide has been published but a threshold limit value of 0.5 mg/m^3 has been proposed (Plunkett, 1976).

Chemical and Physical Data

1. Chemical Abstract No.: 506-68-3.
2. Synonyms: Bromine cyanide, bromocyanogen; TL 822.
3. Chemical structure and molecular weight: $\text{Br}-\text{C}\equiv\text{N}$, 105.93.
4. Density: solid, $d_4^{20} = 2.015$; liquid: 1.881 (54°C); vapor: 3.6 (air = 1) (ILO, 1971).
5. Absorption spectroscopy: Cyanogen bromide exhibits continuous ultraviolet absorption in the range of 254 to 184 nm (Mooney and Reid, 1931). The infrared (Freitag and Nixon, 1956), Raman (West and Farnsworth, 1933), and mass spectra (Herron and Dibeler, 1960) have been described.
6. Volatility: Vapor pressure is 92 mm Hg at 20°C . Weast (1982), p. D-203, lists vapor pressures over the range of -35.7 to $+61.5^\circ\text{C}$. The Antoine equation for the range of -17.3 to 35°C has been published (Baxter et al., 1920).
7. Solubility: Cyanogen bromide dissolves freely in water, alcohol, and ether. Useful solvents for handling cyanogen bromide, for instance in affinity chromatography, are: N-methylpyrrolidone, dimethylformamide, 2-methoxyethanol, and DMSO (Nishikawa and Bailon, 1975).
8. Description: Colorless needles which change to cubes. Pungent odor.
9. Boiling point: 61.4°C ; melting point: 52°C .
10. Stability: Pure cyanogen bromide, completely dried by distillation over sodium, is stable in a desiccator over several months. Impure material, particularly in presence of traces of bromine, decomposes rapidly or polymerizes to cyanuric bromide, $(\text{CNBr})_3$. This reaction may be explosive (Williams, 1948; Grossman, 1980).

11. Chemical reactivity: Cyanogen bromide is instantly hydrolyzed by aqueous alkali hydroxide to alkali cyanide and bromide. The cyanide can then be oxidized by sodium or calcium hypochlorite to the much less toxic cyanate ion. It reacts with ammonia to yield cyanamide, and with hydroxylamine in alcohol-ether solution to yield hydrogen cyanide and hydrogen bromide in an explosive reaction.
12. Flash point: No data.
13. Autoignition temperature: No data.
14. Explosive limits in air: No data.

Fire, Explosion, and Reactivity Hazard Data

1. Major hazards from cyanogen bromide to fire-fighting personnel are due to its volatility (effects on nose and throat) and the possibility of explosion. Complete protective clothing and air-supplied respirators, or respirators with cyanide-type chemical cartridges, with full-face masks should be worn.
2. Flammability is likely to be low.
3. Conditions contributing to instability are likely to include high temperatures which may lead to explosive polymerization.
4. Hazardous decomposition products have not been identified but are likely to include cyanogen and hydrogen cyanide.

Operational Procedures

It should be emphasized that this data sheet and the NIH Guidelines are intended as starting points for the implementation of good laboratory practices when using this compound. The practices and procedures described in the following sections pertain to the National Institutes of Health and may not be universally applicable to other institutions. Administrators and/or researchers at other institutions should modify the following items as needed to reflect their individual management system and current occupational and environmental regulations.

1. Chemical inactivation: Validated methods have been reported (Lunn and Sansone, 1985).
2. Decontamination: Turn off equipment that could be affected by BrCN or the materials used for cleanup. If there is any uncertainty regarding the procedures to be followed for decontamination, call the NIH Fire Department (dial 116) for assistance. Use absorbent paper to mop up spill. Wipe off surfaces with 4% sodium hydroxide, then with 5% sodium

hypochlorite, then wash with copious quantities of water. Glassware should be rinsed (in a hood) with 4% sodium hydroxide then with 5% sodium hypochlorite, followed by soap and water. Animal cages should be washed with 4% sodium hydroxide, then with 5% sodium hypochlorite, and finally with water.

3. Disposal: It may be possible to decontaminate waste streams containing BrCN before disposal. For details, see Lunn and Sansone, 1985. No waste streams containing BrCN shall be disposed of in sinks or general refuse. Surplus BrCN or chemical waste streams contaminated with BrCN shall be handled as hazardous chemical waste and disposed of in accordance with the NIH chemical waste disposal system. Nonchemical waste (e.g., animal carcasses and bedding) containing BrCN shall be handled and packaged for incineration in accordance with the NIH medical-pathological waste disposal system. Potentially infectious waste (e.g., tissue cultures) containing BrCN shall be packaged for incineration, as above. Burnable waste (e.g., absorbent bench top liners) minimally contaminated with BrCN shall be handled as potentially infectious waste and packaged for incineration, as above. Absorbent materials (e.g., associated with spill cleanup) grossly contaminated shall be handled in accordance with the chemical waste disposal system. Radioactive waste containing BrCN shall be handled in accordance with the NIH radioactive waste disposal system.
4. Storage: Store solid BrCN and its solutions in sealed ampoules or in bottles with caps with polyethylene cone liners inside a sealed secondary container. BrCN should be kept in a solvent storage cabinet, deep freeze, or explosion-safe refrigerator. Avoid exposure to light and moisture.

Store working quantities of BrCN and its solutions in an explosion-safe refrigerator in the work area.

Monitoring and Measurement Procedures Including Direct Field Measurements and Sampling for Subsequent Laboratory Analysis

A colorimetric procedure for the determination of cyanogen bromide (limit of detection \approx 3 ppm) has been described (Lunn and Sansone, 1985).

Biological Effects (Animal and Human)

1. Absorption: Cyanogen bromide is absorbed and produces toxic effects by inhalation, ingestion, and through the skin. It is a potent eye and nose irritant.
2. Distribution: No specific data are available.
3. Metabolism and excretion: There are no data on the subject. It may be assumed that, upon entering the organism, cyanogen bromide is quickly hydrolyzed to bromide and cyanide, and the

metabolism of the latter follows usual pathways (detoxication of rhodanese to thiocyanate, which is the major urinary excretion product of cyanide).

4. Toxic effects: No quantitative toxicity figures have been published. Exposure to cyanogen bromide produces the following systemic symptoms attributable to cyanide: headache, dizziness, hyperpnea, nausea, and vomiting, followed (in the absence of prompt treatment) by convulsions and death. In addition, topical symptoms are found: lacrimation and acute and delayed respiratory effects including pulmonary edema. At low concentrations (e.g., 10 ppm or below) these may be the preponderant toxic effects (ILO, 1971; Plunkett, 1976).
5. Carcinogenic effects: None have been reported.
6. Mutagenic and teratogenic effects: None have been reported.

Emergency Treatment

1. Skin and eye exposure: For skin exposure, remove contaminated clothing and wash skin with soap and water. Skin should not be rinsed with organic solvents. Since BrCN is readily absorbed through the skin, avoid rubbing of skin or increasing its temperature. For eye exposure, irrigate immediately with copious quantities of running water for at least 15 minutes. Obtain ophthalmological evaluation.
2. Ingestion: Drink plenty of water or milk. Induce vomiting. Refer for gastric lavage.
3. Inhalation: Remove victim promptly to clean air. Administer rescue breathing if necessary.
4. Refer to physician at once. Consider treatment for pulmonary irritation.

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